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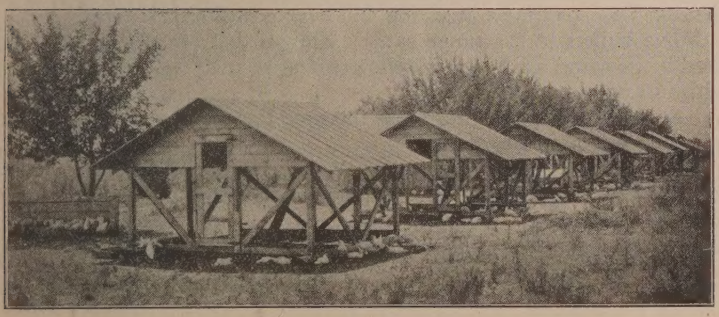
Brooding and Pullet Development

(Extension Bulletin No. 84, Revised)



COOPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS OF THE STATE OF IDAHO UNIVERSITY OF IDAHO EXTENSION DIVISION AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

POULTRY SECTION

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Summary

THE measure of a poultryman's success is his ability to produce good pullets.

The brooder should be in order and well heated before the chicks are received.

Liquid milk is the best first drink and feed for baby chicks.

Alfalfa is the best source of green feed and vitamin A; it should constitute a part of the ration throughout the growing period. White clover is also good.

Yellow corn has the greatest feeding value of any of the grains for growing poultry.

Separate cockerels from pullets as early as it is possible to determine the sex. By so doing congestion and overcrowding will be relieved.

Move pullets to the range early. Ranges that are dry while being used by growing stock provide the greatest security against infestation with intestinal parasites.

Keep the pullets growing from the time they are hatched until they have reached maturity.

Approximately eight pounds of feed are required to grow a chick to 12 weeks of age and about 25 pounds of feed to produce a pullet 5½ to 6 months of age.

A practice that has proved successful should not be discarded until a better one is known.

Brooding and Pullet Development

By

Pren Moore, C. E. Lampman, J. K. Williams, and Hobart Beresford*

GROWING pullets to maturity with the necessary stamina and vitality to withstand continued high production involves one of the major problems of the poultry industry. Such pullets must have a fully developed body, a large digestive capacity, an abundance of yellow pigment, and must be well fleshed, and free from disease and parasites.

A combination of good management and feeding is essential to make pullets yield a profit; it is important, therefore, to understand the factors involved. The most important are: (1) quality and condition of breeding stock, (2) brooding practices, (3) range management, (4) feeding practices, (5) nutritional requirements, and (6) sanitation and disease control. Each factor has a definite influence on pullet development which determines the extent to which they may or may not be profitable. Well-developed pullets feed better, take on flesh more rapidly, and are less susceptible to colds, roup, and other diseases than poorly-developed birds. The problems of feeding for winter egg production are simplified with pullets that have been well grown and properly finished.

This bulletin deals primarily with the problems involved in raising good pullets; however, selection and physical condition of breeding stock are limiting factors which determine to a marked extent the possiblity of developing chicks into useful stock. Immature and physically weak stock should not be used for breeding purposes. Breeding stock should have a long rest period in which to regain their flesh and vitality in advance of the breeding season. Restoration of the life-producing elements are essential to insure efficiency in breeding stock.

BROODER HOUSES

The shed-roof type of house is recommended regardless of the system of brooding since it is cheap and easy to construct and as efficient as the more expensive types.

The depth of 16 feet is recommended for the permanently located brooder house as being most suitable for average conditions; for large units a depth of 20 feet is suggested. The advantages of the greater depth are: (1) less draft, (2) more feeding space between the hover and the front wall, (3) greater opportunity for chicks to choose the temperature best adapted to their comfort, thereby reducing the danger of devitalizing the chicks from overheating and the probability of danger from overcrowding, piling, and smothering.

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Insulation of the walls by sheeting the inside and filling the space between with some kind of insulating material such as shavings, sawdust, or cut straw will increase the efficiency of the brooder house. A uniform temperature is more easily maintained, floor drafts reduced,

Fig. 1.—Permanent furnace-type brooder house showing the location of the furnace and flue as originally designed.

and feed costs lowered. It is usually impractical to insulate portable type houses in this manner as it is likely to make them too heavy to move.

The style of front and window arrangement illustrated allows a simple means for ventilation without floor drafts, by opening the windows at the top to any position desired and fastening with some type of homemade device. This style gives sufficient light in the building, and a maximum amount of sunlight on the floor by dropping the top window clear down or by removing the windows entirely on warm sunny days. For this reason the upper sash is hinged to the lower one to open inward. The entire window is held in place with buttons or clamps in order that it may be easily removed.

Floor. For sanitary reasons, which are discussed in greater detail under that heading, concrete floors are recommended in permanently

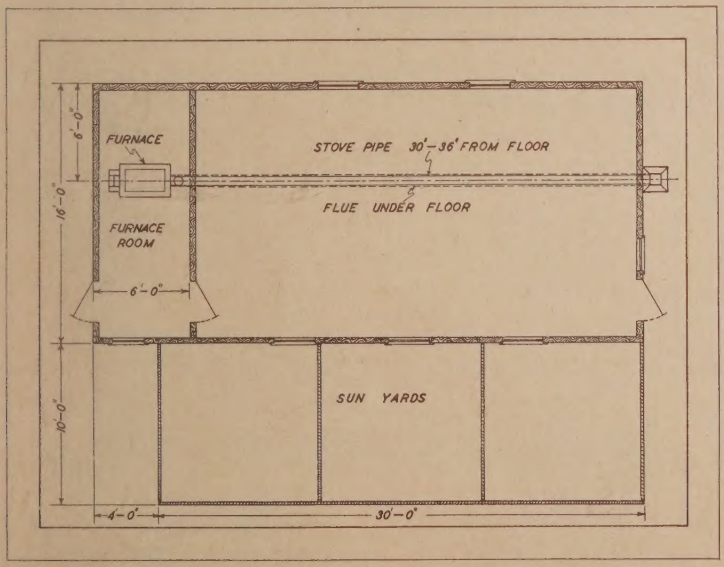

Fig. 2.—Floor plan of permanent brooder house and sun yards. Note that the center of the flue is 6 feet from the rear wall.

located brooder houses. The floor should be well constructed with some type of insulating material underneath to stop the upward movement of moisture, and should be finished with a smooth surface. A thickness of two inches is ordinarily sufficient for brooder houses, and in no instance is a thickness of more than three inches justified. Since colony house floors are necessarily of wood, it is recommended that they be of double thickness with paper between.

The Furnace Type Brooder House

This system has been developed in the field with the view of accommodating large numbers of chicks in single units. Superior

features claimed by the users are that the building is inexpensive, the heating unit is simple and cheap to construct, the heating cost is low, and a dependable and uniform temperature is provided if operated according to instructions. It is particularly adapted to those areas where cheap or waste wood is available as a fuel. Coal may be used but is not generally as satisfactory as wood because of the accumulation of soot. The fire is easily started by placing pieces of burlap saturated with kerosene in the cleanout at the base of the chimney and in the furnace; the burlap in the chimney is lighted first. This will develop a satisfactory draft and warm the chimney. About three days are required to heat the floor properly; however, when once heated it cools very slowly.

Supplementary room heat may be necessary while the chicks are small, especially during the early part of the season. Such heat may be provided by some type of quick heating stove or by the stovepipe arrangement running through the length of the brooder house as illustrated in Figure 3.

Furnace Construction. The details of construction for the regular type furnace is illustrated in Figure 4. It will be observed that the

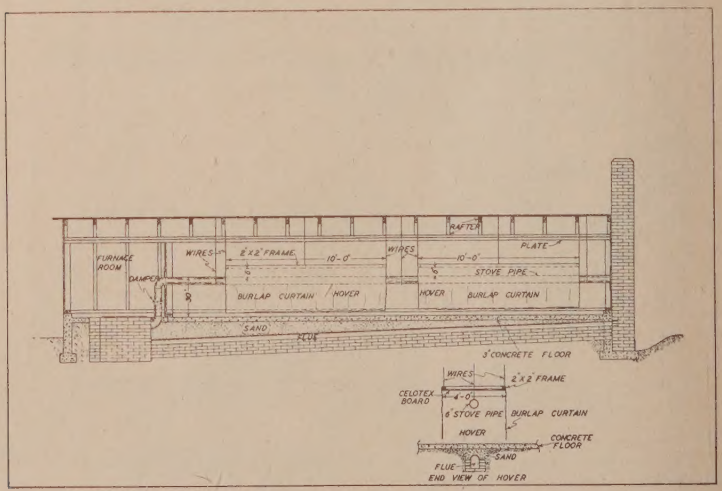

Fig. 3.—A modification of the underground heating system in which a stove pipe is incorporated for additional hover heat and supplementary room heat. If desired for room heat only it may be put above the hover instead of underneath as shown.

furnace is 16 inches wide, 30 inches long, and 30 inches deep (inside measurements). In terms of brick the furnace is 4½ bricks long, 3 bricks wide, and 13 bricks high. It should be laid up in mortar in a permanently located house. The bottom of the furnace may or may not be lined with brick. The floor level of the brooder house is the basis of all construction, especially in figuring the depth of the furnace and the flue under the floor. The top or cover of the furnace needs

to be of such a material that it will not warp; maleable cast iron appears to give the best service.*

A modification in the construction and operation of the furnace is illustrated in Figure 5. This type allows the furnace to be fired through the door in the front end. A pit in front must necessarily be provided for this purpose. The chief advantage of this type is that smoke and sparks do not come from the furnace while firing.

Flue. The top of the flue should be approximately 12 inches below the floor level at the furnace and 4 inches below the floor level at the chimney. From this description it will be noted that the flue is built on a slant for the purpose of developing proper draft and securing a uniform heat throughout the length of the flue. A flue that is laid beneath a concrete floor should be of a type of material that will insure permanency. Ordinary clay sewer or drain tile cannot be regarded as such. If tiling is used it should be of fire clay. Whatever the type of flue, it should have a capacity equivalent to 8 inches in diameter. Figure 4 illustrates a flue with brick side walls (3 bricks high) and a maleable cast-iron top. To aviod the possibility of the flue being filled by rodents a solid bottom (preferably of concrete) is necessary. The cleanout hole in the chimney should be provided as indicated in Figure 1. Should the flue fill with soot it may be cleaned by running a wire, to which is attached a burlap mop, through the flue. The chimney at the end of the building should be of brick laid up with mortar.

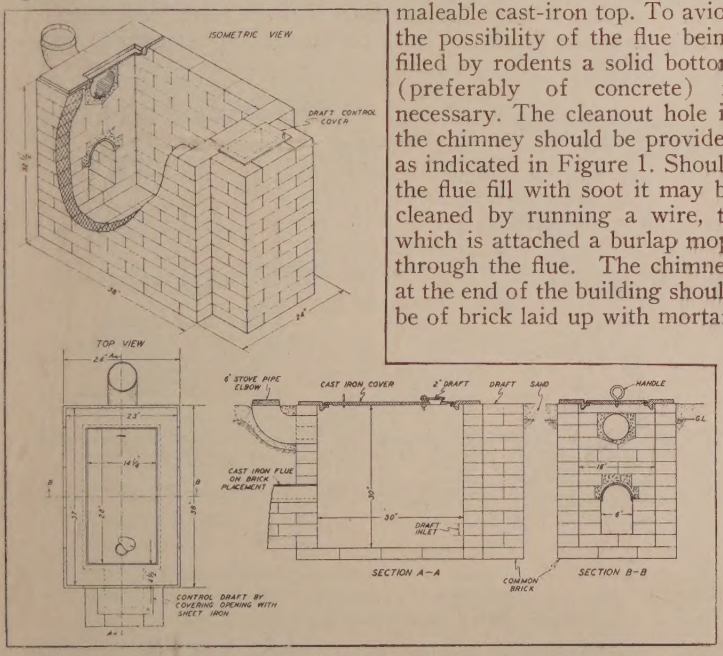

Fig. 4.—Showing the details of construction for the original-type underground furnace.

Portable Colony Brooder House

This is a smaller house built on skids in order that it may be easily moved to new locations. The 10x14 size illustrated in Figure 7 is as

*Cast iron arch, furnace cover and clean-out doors for flue may be secured from the Weiser Iron Works, Weiser, Idaho.

large as can be conveniently moved under average conditions. In case facilities are available for moving a heavy house a larger size may be used. Regardless of the size built, the house should be deeper from front to back than from side to side, in order to provide sufficient space for feeding troughs in front of the hover.

BROODING

In brooding, regardless of the system used, the aim is to provide a uniform dependable temperature with sufficient heat for comfort and sufficient floor area to allow the chicks to select their own degree of comfort. Lack of heat allows the chicks to become chilled, causing them to crowd, pile, and smother, which usually results in the development of digestive disorders. On the other hand, too much heat will devitalize the chicks. In any brooding system there should be a definite source of heat that the chicks can go to or from as their comfort requires. The heat supplied by the brooder should be sufficient to warm the chicks at any time they require it. It is desirable, therefore, to maintain sufficient hover heat in order that the room temperature can be kept as low as possible. Such conditions are essential to produce

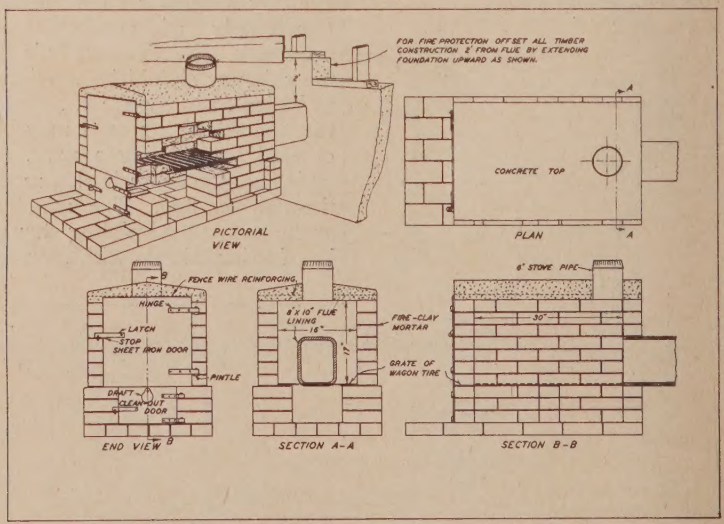

Fig. 5.—Showing the details of construction for the style of underground furnace to be fired through an opening in front end.

hardy, vigorous chicks. In other words, it is never advisable to operate the room temperature any warmer than is necessary. It is essential to teach the chicks the source of heat whether they are day-old chicks or battery-started chicks. This may be accomplished by the use of some type of floor guard patterned after that illustrated in Figure 7. The floor guard should be adjustable and if properly used has a double purpose: first, to confine the chicks to the heated area until they are hover broken and second, to prevent floor drafts from the window

openings in the front of the house from sweeping across the floor to the front of the brooder. When such a floor guard is used in the front it can be moved to or from the brooder as the conditions may require and result in a more even distribution of chicks around the hover. As stated previously, a proper brooding condition is one in which the chicks will settle down and give evidence of being comfortable. The behavior of the chicks is always a more dependable guide to correct temperature than a thermometer.

Types of Brooders

The Furnace Type Brooder. In this type of brooder, the construction of which has been previously discussed, a strip of floor about 10 inches wide is heated through the length of the house until it feels quite warm to the hand, and yet not hot.

Two types of hovers are in use: the original type illustrated in Figure 6, which merely consists of a hover over the flue for the purpose of concentrating the heat, and the modified hover used in conjunction with the stovepipe arrangement illustrated in Figure 3. The latter is

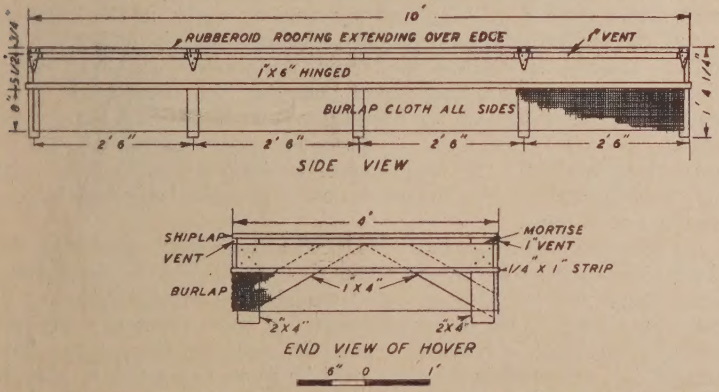

Fig. 6.—Hover to be placed over the underground flue in the original type of the underground heating system illustrated in Figure 1.

designed to serve a two-fold purpose—first, to provide overhead heat in addition to that supplied by the flue; and second, to supply supplementary room heat. The top of the hover may consist of a strip of composition board, attached to a frame. Cloth or burlap is hung from the edge of the hover to within two or three inches of the floor. The hover should be built in sections of about 8 or 10 feet long.

The stovepipe arrangement is particularly advantageous in supplying room heat early in the morning when the chicks are inclined to remain under the hover because of a cold room. The heat through the pipe is controlled by the damper in the upright joint at the furnace. By opening the damper, heat flows through the pipe and the space under the hover is warmed very quickly. The hover curtain can then be raised temporarily, allowing the surplus heat to escape into the room. When the house is comfortable and the chicks are feeding freely, the

room temperature may be reduced by restricting the flow of heat through the pipe.

The coal burning brooder stove is most commonly used as a source of heat in the portable-type houses. The walls of this type of house are usually only single boarded which necessitates a reserve of heat such as the coal burning brooder stove is capable of providing. The reserve of heat is also advantageous in that it allows the practice of opening the windows on sunny days to admit direct sunlight even though the outside air may be quite chilly. The stove should be of a large capacity to make it dependable for burning soft coal; it should be equipped with a 5-inch pipe provided with a damper. The larger size pipe provides better draft and is more efficient in preventing creosote from clogging the opening at the top of the stove.

Electric brooders have commanded considerable interest in recent years. They have several distinct advantages and disadvantages. The chief advantages are: less routine in operation, reduced fire hazard, and the possibility of discontinuing the heat during the middle of hot days. The disadvantages are: the difficulty in maintaining sufficient room temperature during cold and windy periods early in the brooding season, the accumulation of excessive moisture, especially on the floor, and the danger of cooling the room temperature too much when windows are open to admit direct sunlight. In recent trials at the Idaho Experiment Station the electric brooder has proved more satisfactory in conjunction with some supplementary room heat and in houses well insulated. As an example, one large house equipped with one coal brooder and two electric brooders provides very satisfactory brooding conditions.

Oil brooders in the past have produced greater fire hazard than any of the other types, and give off fumes that are likely to be detrimental to the chicks; however, more recent models have eliminated many of these difficulties. This is especially true of those types in which the burner is enclosed in a metal drum. In most sections of the state both the oil and electric brooders will be more expensive to operate than the coal burning or underground systems.

Prevention of Floor Drafts

During the early part of the season some precaution is necessary to prevent cold floor drafts when windows are open to admit direct sunshine. The floor guard previously mentioned may be used to accomplish this purpose by moving it close to the edge of the hover while the windows remain open. This arrangement will provide a warm area under the hover and a cool feeding area in the front part of the brooder house. In the furnace type brooder the same condition can be obtained by lowering the hover curtain closer to the floor.

Sleeping Conditions for the Chicks

Thrift in chicks is influenced as much by the sleeping conditions as by the feed and management. The temperature near and under the hover should be such that chicks will settle down without crowding. The room temperature at the time the chicks begin to settle should be

cool enough so that they will naturally go to the hover. The floor guards should be moved far enough away from the brooder so that the chicks will not be confined too closely to the heat. Regardless of the type of brooder, the tendency of the chicks is to congregate and settle in the most comfortable areas provided they have been properly hover broken. The greater the air capacity of the hover, the more healthful the condition provided. This is a particular advantage of the high hover recommended in conjunction with the stovepipe arrangement as it is in Figue 3. During the night the ventilation should be such that the cool air will be admitted through the top window openings near the ceiling. Chicks that sleep comfortably during the night greet the attendant in the morning with an evidence of vigor and vitality. Chicks that crowd, sweat, become chilled, or are otherwise uncomfortable

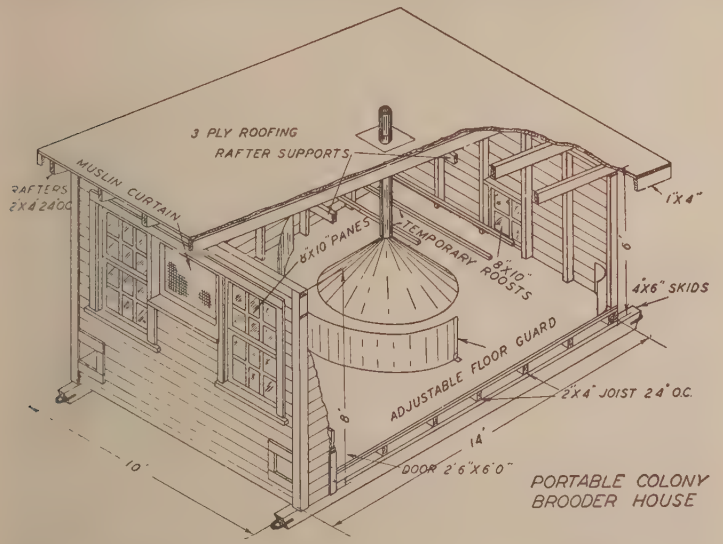

Fig. 7.—Portable colony brooder house easily moved to clean land each season.

during the night are devitalized and exhibit very little evidence of thrift or desire for feed.

Roosting

Chicks should be encouraged to roost as early as possible. This can best be accomplished by the use of slanting frames, covered with 1-inch mesh wire, extending from the floor near the hover to about 18 inches high at the rear or side walls. Perches may be placed on the top of these frames at the beginning and moved to a higher level later on. The slanting frames encourage the chicks to roost, thus avoiding crowding and eliminating some of the direct contact with droppings.

Direct Sunlight for Early Chicks

Inasmuch as the rays of the sun contain ultra-violet light, which is an important factor in proper mineral assimilation, the early chicks should

have access to as much direct sunshine as weather conditions will permit. It must be remembered that the ultra-violet rays do not pass through ordinary window glass; therefore, in order to be useful, direct sunshine must be admitted through openings. During chilly weather it is safer to provide the direct sunshine by admitting it into the brooder house than to force the chicks out of doors. Windows should be sufficiently high above the floor to prevent cold winds blowing directly on the chicks, yet providing sunshine on the floor. The double sash window illustrated in Figures 1 and 7 are so arranged that the upper sash is hinged to the lower and the entire window held in place by buttons or clamps. With such an arrangement direct sunshine may be admitted to whatever extent the weather conditions permit.

It is also desirable to get chicks out of doors into the direct sunshine as early as possible. Placing feed troughs just outside the chick door will encourage them to go outside.

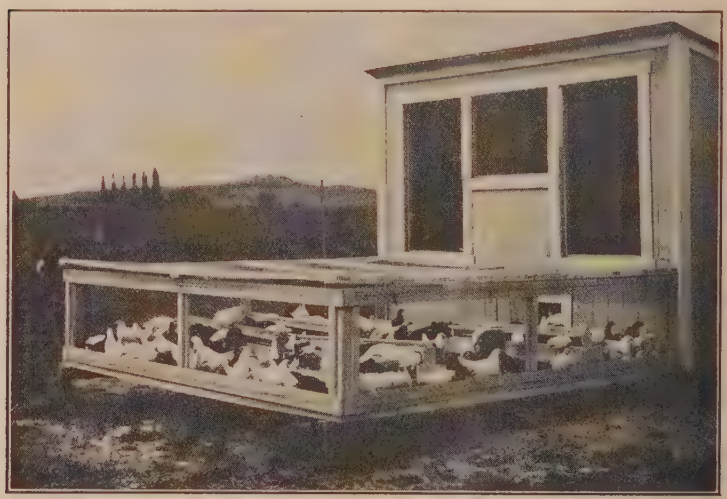

Fig. 8.—A wire-floored sunyard is satisfactory during the brooding period when the house is permanently located. The floor is made of sections; ½-inch mesh hardware wire, or ¾-inch hexagonal mesh wire may be used.

Sanitary Precautions

Producing healthy pullets, free from disease, has become the limiting factor to poultry raising. All practices which will increase the likelihood of chicks becoming infected during the brooding stage should be avoided. The *prevention* of disease or parasitic infestation is always more effective than treatment.

In many instances pullets are unthrifty as the result of disease and parasitic infestation which *started* during the brooding period. Direct contact with droppings, damp litter, and tracking infection to the brooder house, are the chief factors to be considered in disease prevention during this period. A *dry floor* and *clean dry litter* are the

principal features in preventing coccidiosis and other parasitic infections.

The elevation of feeders and drinking fountains on platforms are aids in keeping the feed and water clean. Some type of reel above the feed troughs to keep the chicks out of the feed and covered drink fountains, are essential features in proper sanitation. (*See Fig. 9*). The wire covered sunyards and the slatted or wire feeder fences used by many poultrymen aid materially in providing the desired sanitation.

Under average farm conditions a regular procedure of moving a portable house to clean ground upon which there has been no poultry

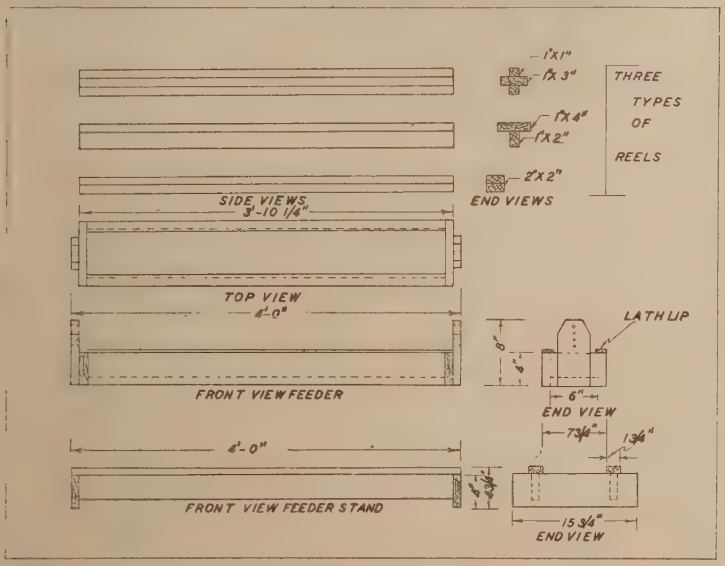

Fig. 9.—Sanitary mash hopper showing three different types of reels. The top plan is the better type although it requires more time to construct.

for two years—or the use of wire-bottomed sunyards in front of the brooder house is essential for producing disease-free pullets. There has been a definite tendency in recent years toward the use of a permanently located brooder house equipped with the wire-bottomed or cement yards (*See Figs. 1 and 8*). The chicks are kept on such yards until they are moved to range.

Under these conditions there is an increased danger of crowding and congestion. The cockerels should be removed as early as it is possible to determine the sex, and pullets moved to range as soon as weather will permit. If the pullets are confined to the wire-bottomed yards or any other brooder too long they tend to develop prematurely, fail to feather properly, and do not obtain proper body development. More detailed information regarding sanitary practices will be found in Extension Circular No. 49, *Prevention and Control of Poultry Diseases.*

Remove Cockerels Early

Cockerels should be separated and removed as soon as possible. Pullets will grow and develop more uniformly when not annoyed by the cockerels. Chicks soon outgrow their quarters and removing the cockerels relieves the congestion. Cockerels are ordinarily sold as broilers as soon as they reach a marketable size which is about two pounds. They may or may not be fattened depending upon individual conditions. If they are fattened they should be confined to a small pen or crate when they weigh about 1½ pounds and given a good fattening ration. Formula No. 15 listed on page 20 is recommended. The mash is mixed with sour milk or buttermilk to about the consistency of thick cream or so that it will pour readily from a pail. Feed this mixture sparingly for the first two days, and then, in such quantities as the birds will clean up in 20 minutes, three times daily. Ten to fourteen days are required to finish them after they have been placed on this fattening feed. It is extremely important not to over-feed the birds for the first two or three days.

RANGE MANAGEMENT

Move Pullets to the Range Early

The date of hatch and the season will determine the age at which pullets can be moved to the range. The weather in most sections is sufficiently settled by June first to permit moving pullets to the range with safety. The open air type range house illustrated in Figures 12 and 13 has come into general use and is especially suitable for housing pullets while they are on range. It is designed to accommodate 100 pullets. Houses of a similar type can be built larger if desired. Panels covered with 1- or 1½-inch mesh are incorporated for the floor, the purpose of which is to prevent contact with droppings.

Provide Sufficient Range. The houses are spaced 200 feet or more apart. When the pullets are taken to the range they should be confined to the house for the first day. Toward evening the doors may be opened and the pullets permitted to go outside. If the feed and water are placed near the door they will be contented and not range far away from the house. As night comes on they will go back into the house and go to the roosts. Pullets from different houses are not likely to mix to any great extent if they are started in this manner when they first are placed on range.

Provide Shade on the Range

Some type of shade sufficient to accommodate the birds without too much crowding is a very necessary feature of range management. If natural shade is available it should be sufficiently high and thinned out to the extent that the sun will have access to the entire surface of the ground during some part of the day. Where natural shade is not available or is insufficient, artificial shade should be provided. Cheap and inexpensive frames may be constructed and covered with burlap. They may be built on skids or built light enough so that two men can easily move them from place to place. It is important to have the height of

such shelters at least as high as the open air houses illustrated. When the shelters are built too low it becomes too hot under them during the extremely hot days in midsummer. This matter of shade is extremely important and is emphasized in this bulletin because of the practice, all too common, of going to the expense of furnishing feed and management, good in other respects, but neglecting shade.

Sanitation on the Range

Dry ground provides the greatest security against infestation with intestinal parasites, in contrast to moist soil, which is an ideal environment for parasitic development. In irrigated sections a green crop should be well established before the pullets are moved to the range. After the pullets are moved out, water should be kept off the land. The prevention of infestation is of such extreme importance that it is preferable to range pullets on dry ground even though it is necessary to grow the green feed in some other place and cut and carry it to them, rather than take the risk involved in irrigating the range.

The range should be as far removed from the laying stock as possible and rotated from year to year, using land that has not had poultry or poultry manure on it for the previous two years.

Move Range Equipment. All range equipment should be moved periodically to prevent the ground from becoming foul with droppings around the house, shelters, or feed hoppers.

Soil-borne organisms and flies are chiefly responsible for infestations of intestinal parasites. Any condition that attracts flies, such as the feeding of liquid milk in hot weather and an accumulation of droppings in or about the range equipment, is to be avoided. Do not allow birds to drink from irrigation ditches or from pools of stagnant water or to congregate continuously in thick clumps of bushes where the soil is likely to continue damp and moist. Proper brooding conditions followed by correct range management constitutes the best prevention against parasitic diseases. Further details and suggestions will be found in Extension Circular No. 49, *Prevention and Control of Poultry Diseases.*

FEEDING

Chicks are hatched with a part of the unabsorbed yolk as reserve food; consequently they do not require feed immediately. In general, chicks need drink after they are 24 hours old and the first feed in small quantities when they are about 48 hours old. The danger of overfeeding chicks is much reduced when starting mashes constitute their first feed. When shipped from any distance they should have feed and drink as soon as they arrive at their destination. The practice at the Idaho Experiment Station has been to remove chicks from the incubator when they are well fluffed and dry and hold them overnight in chick boxes. On the afternoon of the following day they are placed in the brooder house and given free access to some form of drink, chick sized oyster shell, and a light feed of starting mash. The extent to which the first feed is given should be governed by the action of the

chicks. It may be just as detrimental to withhold feed too long as to feed too soon.

Basic Requirements for Chick Rations

A good ration is one that provides a proper balance of the following supplements:

1. *Vitamins*
   Vitamin A—Promotes growth, health, and resistance to disease; prevents nutritional roup. Principal sources—green leafy portions of plants (particularly alfalfa and clover), yellow corn, green-seeded peas, cod liver oil, carrots, and water cress.
   Vitamin D—Promotes efficient mineral assimilation and proper bone development; prevents rickets (leg weakness, crooked keels, and other malformations). Principal sources—cod liver oil and sardine oil. Ultra-violet rays of direct sunshine have the same beneficial effect in mineral assimilation.
2. *Proteins*—Promote growth and development. Principal sources of animal protein—liquid skim milk or buttermilk, dried milk, meat scrap, fish meal.
3. *Minerals*—Calcium and phosphorus, particularly important in bone formation. Principal sources—oyster shell, high grade calcite, and granulated bone.

The vitamin and mineral requirements are particularly important for early-hatched chicks or those reared in confinement. Complete rations for growing chicks and pullets should be considered as an investment. Pullets that are well grown will have the necessary vitality and physical reserve to withstand heavy production; poorly grown pullets are always a liability.

Vitamin A

The importance of the vitamin A supplements previously listed has been conclusively demonstrated in recent feeding trials conducted at the Idaho Experiment Station. Basal rations in which the grain supplements consisted of the so-called white grains; namely, wheat, oats, and barley, (all of which are deficient in vitamin A) and in which none of the above supplements were provided, resulted in a mortality of 100 per cent of the chicks by about 8 weeks of age. By supplementing such rations with an adequate amount of any one, or a combination of the vitamin A supplements listed, normal growth and thrift were secured. The chicks receiving rations deficient in this vitamin exhibited various symptoms depending upon the extent to which the ration was deficient. The more typical symptoms consisted of a wobbly gait, sore eyes, swelling under the throat, excessive mucous in the mouth, ruffled feathers, extreme paleness of skin, beak, and shanks, and a general lack of thrift. The internal lesions consisted of extreme paleness of the kidneys in the early stages, followed later by a characteristic white network of urate deposit in the kidney tissue, enlargement of the ureters with an accumulation of urates, enlargement of the gall bladder

and proventriculus, and in advanced cases, typical white abscesses or "pustules" on the mucous membrane in the throat and upper esophagus.

Alfalfa leaves of good quality or alfalfa leaf meal is known to be several times more potent in vitamin A than yellow corn. Dehydrated or artificially cured alfalfa leaf meal is several times more potent than ordinary sun-cured alfalfa. When the quality of local alfalfa is poor the dehydrated alfalfa leaf meal is one of the cheapest vitamin A supplements to be obtained; it should be incorporated in the mash at the rate of about 5 per cent. Inasmuch as alfalfa is produced abundantly in almost every section of the state, it should be freely incorporated in all rations as the most logical and economical vitamin A supplement. While yellow corn is recognized as the one grain rich in this vitamin, it is not generally grown in many sections of this state. The use of corn, therefore, will necessarily be influenced by price and availability; in any event it should be used to the extent that the price permits.

Recent trials at the Idaho Experiment Station have demonstrated that peas of the green-seeded varieties are also rich in vitamin A, having about the same relative potency as yellow corn. Yellow-seeded varieties, however, are not a good source of this vitamin. In localities where peas are available as a feed they may be incorporated in the ration by using from 10 to 20 per cent of ground peas in the mash mixture. (See mash No. 9, page 19).

In many instances the lack of vitamin A constitutes the limiting factor in securing satisfactory results from a ration—in other words, pale unthrifty pullets are the result of feeding wheat, oats, and barley with no vitamin A feeds. Proper combinations of alfalfa, cod liver oil, ground corn, or ground peas, supplementing the white grains will make the difference between cull and profitable pullets.

Vitamin D and Mineral Requirements

The requirements of growing chicks for vitamin D and calcium and phosphorus are very closely linked in that both are necessary for normal mineral assimilation and bone development. The vitamin D supplement is particularly necessary for early-hatched chicks due to the absence of the ultra-violet ray of direct sunshine. A deficiency of either mineral supplements or the vitamin D factor causes a lack of proper calcification of the bone, resulting in *rickets,* more commonly known as *leg weakness.* Oftentimes mineral metabolism may be deficient only to the extent of reducing proper growth and bone development without leg weakness actually occurring as such until a more advanced stage of malnutrition is reached. As previously stated, this phase of the ration needs special emphasis when early-hatched chicks are being brooded inside. The ultra-violet rays of direct sunlight or a vitamin D supplement is necessary to promote proper calcium assimilation and normal bone development under such conditions.

The calcium and phosphorus are ordinarily supplied in the form of chick-sized oyster shell and granulated bone. Oyster shell is added to the ordinary chick ration at the rate of 2 to 4 per cent. The amount of granulated bone will depend upon whether liquid skim milk or meat scrap is used as a source of animal protein and the ash analysis of the

bone meal. The amounts recommended are on the basis of the ordinary "raw" bone meal which runs lower in ash than the steamed bone meal. If meat scrap is used which contains a high percentage of ash then the amount of granulated bone will obviously be less. It will be noted that the chick mashes listed on page 19 contain from 2 to 3 per cent. More than this amount should not be added inasmuch as an excess of phosphorus may upset the mineral balance and produce leg deformities commonly called *"slipped tendons."*

Cod Liver Oil. The most common source of vitamin D is cod liver oil although recent tests have proved sardine oil to be a reliable source of this vitamin. Practically all of the various brands of cod liver oil now available are biologically tested, and such grades should be insisted upon by the purchaser. The ordinary commercial grades are used at the rate of from 1 to 2 per cent of the total rations for chicks during the period they are confined indoors. Concentrated grades of cod liver oil are now available and if used should be incorporated according to the instructions of the manufacturer. The oil is most readily added to the mash by first mixing into 10 to 15 pounds of bran then thoroughly mixing this with the rest of the ration.

Animal Proteins

The animal protein supplement is provided by the use of liquid skim milk as a drink or by the use of a combination of dried milk, meat scrap, and fish meal, in the mash mixture as listed in the rations on page 19.

Liquid skim milk furnishes the animal protein most efficiently utilized by chicks, and when available should be the chicks' first feed. If it is used, the mash should be similar to No. 7 on page 19 in that it should contain no other animal protein for normal growth. For many poultrymen, the safest way to use milk is to feed it sour; however, if milk is being separated on the farm it may be fed fresh from the separator each day.

The milk founts should be cleaned thoroughly every morning and care should be taken to prevent accumulation of mold in the top. During extremely hot weather, milk should be fed only in quantities that will be consumed in a few hours, and a fresh supply provided several times during the day. The fountains should be of such type as to keep the chicks out of the milk. Tin, enamel ware, or crockery vessels are preferred for milk. The zinc coating of new galvanized fountains is readily attacked by the lactic acid of sour milk, resulting in a compound poisonous to chicks. New galvanized utensils should be allowed to stand for two or three days filled with sour milk, or until the inside surface takes on a darkened color, then after a thorough cleaning they may be safely used.

When animal protein is provided in the mash a combination of dried milk, meat scrap, and fish meal, is preferable (See formula No. 8, page 19). Fish meal and meat scrap should always be of good quality.

The animal protein should be reduced as outlined under Feeding Practices. If high protein mashes are continued too long a *premature development of pullets* is produced that cannot be rectified.

Fibre

The digestive tract of young chicks cannot satisfactorily utilize great quantities of fibrous feeds, such as oats and barley. Such fibrous feeds should therefore be used in limited amounts until the chicks are 8 or 10 weeks of age. When alfalfa is used as a source of vitamin A the leaves and leaf meal are preferable. Alfalfa stems are high in fibre, contain very little vitamin A, and therefore, may be detrimental rather than beneficial.

RATIONS

It is recognized that many combinations of the more suitable grains and supplements may give satisfactory results when the basic requirements, such as vitamins, proteins, and minerals are present in adequate proportions. Feed formulas developed at the Idaho Experiment Station and generally used by poultrymen throughout the state are given below. They have certain definite principles and a proper balance of the supplements incorporated; if not used exactly as listed they may serve as guides by which to utilize the home-grown feeds of a given locality to the best advantage.

SUGGESTED CHICK RATIONS

No. 7

	100 lb. Basis	1 Ton Basis
Bran	16	320
Ground oats	15	300
Ground yellow corn	30	600
Ground wheat	25	500
Alfalfa leaves	5	100
Oyster shell	4	80
Bone meal	3	60
Salt	1	20
Cod liver oil, qts.	1	20
Per cent protein	11.7	

Starting mash with liquid skim milk as a drink.

No. 8

	100 lb. Basis	1 Ton Basis
Bran	16	320
Ground oats	10	200
Ground yellow corn	35	700
Ground wheat	10	200
Meat scrap	3	60
Fish meal	3	60
Powdered milk	10	200
Alfalfa leaves	5	100
Oyster shell	4	80
Bone meal	2	40
Salt	1	20
Cod liver oil, qts.	1	20
Per cent protein	15.6	

Starting mash when no liquid milk is available.

No. 9

	100 lb. Basis	1 Ton Basis
Bran	16	320
Ground oats	10	200
Ground yellow corn	20	400
Ground wheat	10	200
Ground peas	15	300
Meat scrap	3	60
Fish meal	3	60
Powdered milk	10	200
Alfalfa leaves	5	100
Oyster shell	4	80
Bone meal	2	40
Salt	1	20
Cod liver oil, qts.	1	20
Per cent protein	17.5	

No. 13
Developing Mash

	100 lb. Basis	1 Ton Basis
Bran	18	360
Ground yellow corn	40	800
Ground wheat	10	200
Ground oats	10	200
Meat scrap	2	40
Fish meal	2	40
Powdered milk	5	100
Alfalfa leaves	5	100
Oyster shell	4	80
Bone meal	2	40
Salt	1	20
Charcoal	1	20
Per cent protein	16.0	

No. 15
Fattening Mash

	Pounds
Ground yellow corn	60
Ground oats	20
Ground wheat (or low grade flour)	20
Chick-size oyster shell	2
Granulated bone	2
Salt	1

Mash No. 7 is to be used when liquid skim milk is available as a drink. Better growth is obtained when milk is given as the sole drink for the first ten days or two weeks, after which water should be given in addition. In order to secure more uniform consumption, milk should be provided during part of the day; for example, in the forenoon, and water the rest of the time. If chicks are carried too long with milk as the sole drink they will mature too rapidly. The ground oats should be of good quality.

Mash No. 8 is suggested when liquid milk is not available. This formula previously contained 45 pounds of yellow corn; the suggested modification is based upon the excellent results of recent feeding trials at the Idaho Experiment Station. Dried milk is recommended at the rate of 10 per cent when the price is not excessive. In localities where the price is unusually high the protein supplements may be dried milk, 6; meat scrap, 5; fish meal, 4.

Mash No. 9 is a modification of No. 8 in that it provides an opportunity to utilize ground peas to replace a considerable portion of yellow corn as a vitamin A supplement. This ration has been used in several trials at the Idaho Experiment Station with very satisfactory results.

Mash No. 13, usually referred to as a developing mash, is designed particularly as a mixture to use in finishing pullets, for the specific purpose of securing body weight and yellow shank color. The high corn content is especially desirable when wheat is given as the sole scratch feed.

Ground peas of the green-seeded varieties may be used to advantage in any of the above mixtures at the rate of 10 to 20 per cent.

Mash No. 15 is a fattening mash for finishing cockerels or other surplus stock for market. It is to be mixed with milk as discussed on page 14.

FEEDING PRACTICES

Start the Chicks Right

The mash is provided continuously from the start. At first, small lath troughs may be used; after chicks are older these are replaced by larger feeders such as are illustrated in Figure 9. The latter is designed to prevent the chicks from getting into it and wasting or contaminating the feed. It is important to provide sufficient mash feeders—8 feet of feeding space to each 100 chicks is about right.

A scratch mixture should be fed in addition to the mash when the chicks are from 10 days to two weeks old. For sanitary reasons it

should be fed in hoppers—the usual practice is to feed it on top of the mash. Cracked yellow corn should be used to supplement whole wheat to the extent that price permits.

Feed should be given outside in the brooder yards as early as possible. It is preferable to provide sufficient hover heat and allow the chicks to run out continuously rather than confine them to the brooder house. When the chicks are old enough to spend considerable time outside, a good practice is to provide feeding spaces through the outside panels which will allow the chicks to feed from troughs placed on the outside of the yards. (*See details in Fig. 1*).

Feeding green-colored alfalfa hay leaves in self-feeders in addition to the 5 percent of alfalfa in the mash proves very beneficial in supplying additional vitamin A for early hatched chicks. Freshly cut green alfalfa or clover should be provided as soon as it is available. *Alfalfa or other green feed is essential throughout the growing period.*

Avoid Premature Development

If rations 8 or 9 are used, the amounts of dried milk should be reduced by one-half when the birds are from 5 to 6 weeks of age; in fact the protein should be reduced at this time in any starting mash. Another way of reducing the protein intake of the ration is to gradually increase the proportion of scratch feed.

The practice of night lighting for the purpose of increasing feed consumption is not advisable except when forcing broilers for market. *Orderly and natural growth is desired.* Any practice of forcing or allowing the premature development of pullets during the growing period is likely to result in an adverse reaction later, such as a fall or winter molt and a decreased annual production.

Prevent Cannibalism

Cannibalism is likely to develop when young chicks are allowed to become restless under congested conditions. Overcrowding, the confinement of chicks too closely to the brooder house, overheated brooder houses, lack of green feed, and irregular feeding practices are some of the more common causes. The trouble starts accidentally in most cases during the stage that the tail and wing feathers are soft and filled with blood at the base; after blood is once drawn the trouble spreads very rapidly. It is suggested, therefore, that measures of prevention be instituted so far as possible.

Chicks should be fed outside in the yard as early as the weather will permit and continuously thereafter. Cockerels should be removed as previously outlined. Alfalfa leaves should be provided in wall feeders from the beginning and cut green feed should be fed in the yards as soon as it is available. The chicks should not be allowed to become excessively hungry or confined inside the house after they are accustomed to run outside. All such practices that will encourage the chicks to come out in the yard and that will keep them contented and busy are worthwhile safeguards against this trouble as it is one of the most difficult vices to control after it has once started and the habit is likely to be carried over after the pullets are put in the laying house.

If the trouble breaks out, the picked birds should be removed at once and treated with some "no-pick" preparation. Several commercial products are available, some of which are quite satisfactory. A common preparation called "protective balsam" has been found to be effective. In the absence of a better remedy, either pine oil or pine tar will prove beneficial. Red paint on the brooder house windows has been recommended by some. It should be remembered, however, that this does not correct the cause of the trouble and should be used only as a control measure in bad outbreaks.

Feeding on Range

The feeding and management of the pullets while they are on range ordinarily requires the least time and attention of any period of their development if the rations are correct, range conditions favorable, and the birds free from parasites. The pullets should continue a normal growth and development until they are ready for the laying house.

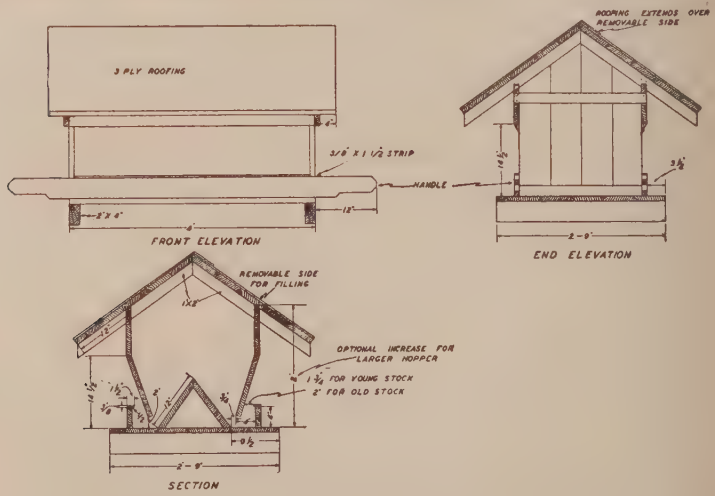

Fig. 10.—Field mash hopper provided with handles so that it can be easily moved.

Feed formulas similar to those previously outlined, except they should contain about 10 per cent of animal protein, are suitable. The exact feed requirements will need to be judged by the development of the pullets. Inasmuch as different strains of pullets develop differently, no thumb rule can be stated. The ordinary practice is to keep mash continuously available in hoppers and feed the grain in troughs in the evening, although some poultrymen allow both mash and scratch feed in hoppers after the birds have been on range for some time. The birds should always have all the grain they will consume at the evening feed with some left over for morning. If such a practice is followed one grain feeding each day is sufficient. One large field mash hopper such as illustrated in Figure 10 should be provided for every one to

two houses. A portable bin on skids which will hold a reserve supply of scratch grain is a very worthwhile convenience. A continuous supply of fresh clean water is necessarily a part of any good feeding program.

Finishing the Pullets

In any flock a few pullets may start laying too early; however, if the percentage of such birds is excessive it should be a warning signal and the feeding program modified to retard the development of the flock as a whole. This is done by restricting the protein and increasing the proportion of grain in the mash, especially the corn content. The aim is to delay comb development and sexual maturity until the bird has attained proper body size and is well fleshed. The pullet should be fat when she comes into production. Formula No. 13 on page 19 is suggested as a developing mash.

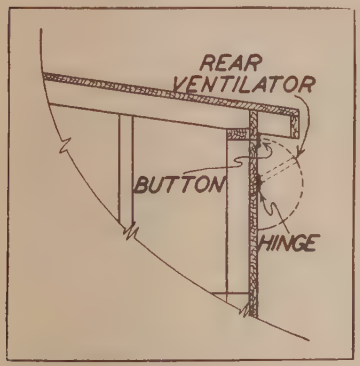

Fig. 11.—A ventilator which may be easily incorporated in the real wall. Such an opening is of particular value during late spring and summer. The openings are one board in width and spaced at various intervals through the length of the building.

If they are infested with intestinal worms they should be treated while they are still on range as outlined in Extension Circular No. 49, *Prevention and Control of Poultry Diseases.*

Move pullets to the laying house as they show the final stage of comb development. This should not be delayed until after they start to lay. It is usually easier to finish the development, especially in the matter of putting on flesh, after the birds have been confined to the laying house. This also provides an opportunity for them to become settled and accustomed to their laying quarters before they come into heavy production. The change from the developing to laying mash should be gradual. To make room for the pullets the old stock should be culled and reduced in late summer. The laying quarters should then be thoroughly cleaned and disinfected. (*See Extension Circular No. 49*).

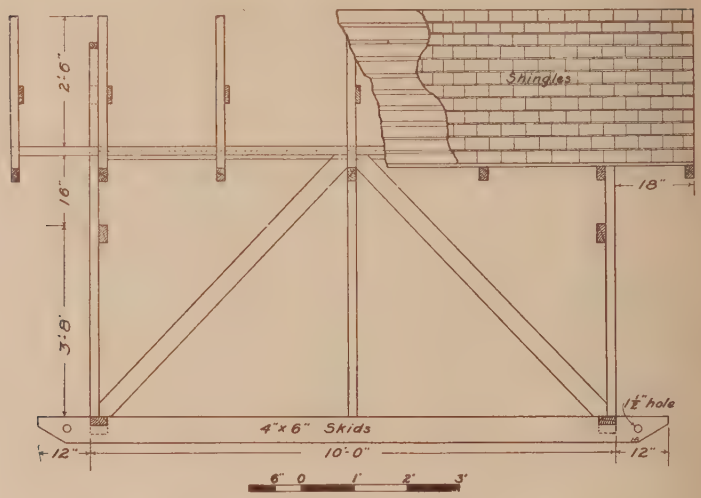

Fig. 12.—Open air house—side elevation. All sides are covered with 1½- or 2-inch mesh wire; floor panels are covered with ¾- or 1-inch mesh heavy gauge wire.

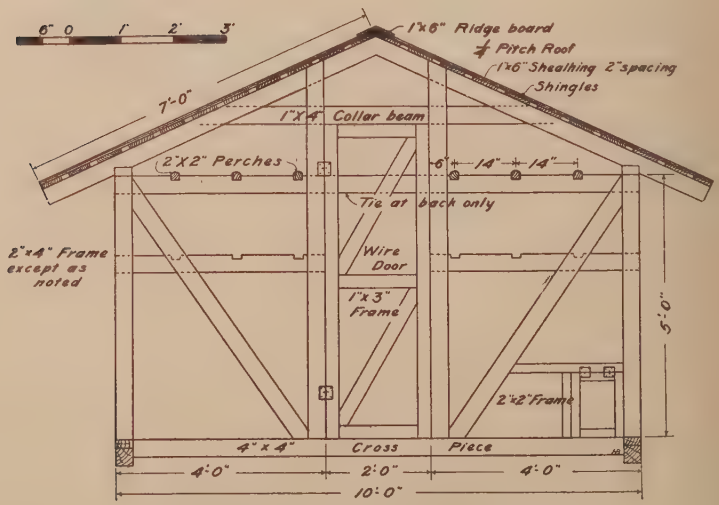

Fig. 13.—Open air house—end elevation.

Permanent Furnace Type Brooder House 34 ft. x 16 ft.

Suggested Bill of Material
Detail of Framing Material

MATERIAL AS BOUGHT				MATERIAL AS USED	
No. of Pieces	Length	Size of Stock	No. of Pieces	Length	Use made of piece
9	16′	2x4	18	7′6″	Studding—front wall.
9	10′	2x4	18	4′8″	Studding—rear wall.
3	16′	2x4			Studding—side wall.
3	12′	2x4			Studding and
6	14′	2x4			Studding partition
Notch studs to extend up to roof boards instead of as shown on cut, page 4.					
3	6′	2x4	3	6′	Joists.
1	10′	2x4	4	2′6″	Window header.
1	8′	2x4	2	4′	Door header.
4	12′	2x4	4	12′	Plate—front.
2	10′	2x4	2	10′	Plate—front.
4	12′	2x4	4	12′	Plate—rear.
2	10′	2x4	2	10′	Plate—rear.
18	18′	2x6	18	18′	Rafters.
4	12′	2x4	4	12′	Sills.
2	10′	2x4	2	10′	Sills
3	16′	2x4	3	16′	Sills.
4	8′	1x4	4	8′	Corner b'd—front.
4	6′	1x4	4	5′	Corner b'd—rear.
1	16′	2x4	4	4′	Window sills.
1	10′	2x6	3	3′	Window sills.
3	10′	1x4	6	4′6″	Window trim.
1	8′	1x4	3	2′4″	Window trim.
4	8′	1x3	8	4′	Curtain frames.
4	10′	1x3	12	3′	Curtain frames.
1	10′	4x4	6	10′	Yard supports.
40	10′	1x4	40	10′	Yard frames.
3	12′	1x4	15	2′	Yard frames.
2	12′	1x2	15	1′4″	Yard frames.
24	10′	1x4	24	10′	Yard floor.
6	10′	1x4	24	2′6″	Yard floor
3	10′	1x10	3	10′	Hopper top.
6	10′	1x4	6	10′	Hopper sides.
3	10′	1x4	3	10′	Hopper bottom.
4	10′	1x6	4	10′	Hover sides.
2	8′	1x6	4	4′	Hover ends.
2	14′	2x4	20	15¼″	Hover frames.
2	8′	¼x1	4	4′	Hover strips.
4	10′	¼x1	4	10′	Hover strips.

SUMMARY

No. of Pieces	Length	Size of Stock	Material	Board Feet
1	10′	4x4	No. 1 Common fir	14
18	18′	2x6	No. 1 Common fir	324
1	16′	2x6	Clear white pine	16
1	10′	2x6	Clear white pine	10
15	16′	2x4	No. 1 Common fir	182
8	14′	2x4	No. 1 Common fir	75
15	12′	2x4	No. 1 Common fir	120
16	10′	2x4	No. 1 Common fir	107
1	8′	2x4	No. 1 Common fir	6
3	6′	2x4	No. 1 Common fir	12
3	10′	1x10	No. 1 Common fir	25
4	10′	1x6	No. 3 Common fir	20
2	8′	1x6	No. 3 Common fir	8
49	10′	1x4	No. 3 Common fir	164
3	10′	1x4	Clear white pine	10
5	8′	1x4	Clear white pine	14
3	12′	1x4	No. 3 Common fir	12
4	6′	1x4	Clear white pine	8
4	8′	1x3	No. 1 Common fir	8
4	10′	1x3	No. 1 Common fir	10
30	10′	1x4	No. 1 Common fir	100
2	12′	1x2	No. 1 Common fir	4
2	8′	¼x1	No. 1 Common fir	
4	10′	¼x1	No. 1 Common fir	
				1249
		1x8	Shiplap, No. 3 common fir	900
		1x6	Rustic siding	650
			Total lumber	2799

MISCELLANEOUS

6 8 in.x10 in. 6-light window sash.
2 10 in.x12 in. 4-light window sash.
2 cellar window sash.
12 3 in. window hinges.
120 ft. ½-inch mesh hardware cloth, 30 in. wide.
150 ft. Hexagonal chick wire, 30 in. wide.
1300 to 1350 brick.
32 ft. iron flue tops.
6 door hinges.
7 rolls roofing.
9 cubic yards concrete (1:2:4 mix.), depending on height of foundation and depth of footing.
2 bundles lath.
40 pounds 8d common nails
8 pounds 10d common nails.
8 pounds 20d common nails.
3 gallons paint.

Colony House 10 ft. x 14 ft.

Suggested Bill of Material
Detail of Framing Material

MATERIAL AS BOUGHT			MATERIAL AS USED		
No. of Pieces	Length	Size of Stock	No. of Pieces	Length	Use made of piece
2	16′	4x6	2	16′	Skids.
6	16′	2x4	6	10′	Rafters.
4	10′	2x4	4	10′	Plates.
3	14′	2x4	6	7′	Studs—front wall.
3	10′	2x4	6	5′	Studs—rear wall.
6	14′	2x4	2	7′3″	Studs—side wall.
Notch studs to extend to roof boards			2	5′10″	Studs—side wall.
			2	6′9″	Studs—side wall.
			2	6′1″	Studs—side wall.
			2	6′7″	Studs—side wall.
			2	6′4″	Studs—side wall.
2	10′	2x4	2	10′	Rafter supports.
10	10′	2x4	10	10′	Joists.
2	12′	2x4	4	6′	Roost supports.
2	10′	2x4	2	10′	Sill.
2	14′	2x4	2	14′	Sill.
1	8′	2x4	4		Window frame.
1	10′	2x6	3		Window sill.
1	16′	2x4	3		Door frame.
5	10′	2x2	5	10′	Roosts.

SUMMARY

No. of Pieces	Length	Size of Stock	Material	Board Feet
2	16′	4x6	No. 1 Common fir	27
1	10′	2x6	No. 1 Common fir	10
9	16′	2x4	No. 1 Common fir	96
11	14′	2x4	No. 1 Common fir	103
2	12′	2x4	No. 1 Common fir	16
26	10′	2x4	No. 1 Common fir	173
5	10′	2x2	No. 1 Common fir	17
			Total for framing material	442
		1x6	No. 1 Siding	370
		1x4	No. 1 Common flooring	175
		1x8	No. 1 Common shiplap	380
		1x4	No. 1 Common pine trim	70
			Total	995
			Total of lumber	1437

MISCELLANEOUS

6 ½ in. carriage bolts 14 in. long.
1 rim lock door set.
4 8″x10″ 6 light barn sash.
1 8″x10″ 4 light barn sash.
2 rolls 3-ply composition roofing.
2 pair 3″ strap hinges.
2 pair 3″ T-hinges.
1 pair strap hinges, 4″ T door.
12 thumb buttons or window fasteners.
20 lbs. 8d nails.
7 lbs. 16d box nails.
1 roll tar paper.
1 gallon paint.

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